

NASAPLANNED DEVELOPMENT PROGRAM FOR MICROSPACECRAFT PRODUCT ASSURANCE

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MICROSPACECRAFT STUDY EFFORT

Why

- Determine existing state of microspacecraft development and status of mission assurance activity
- Identify mission assurance activities which enable acceleration of new technologies or improve schedule/cost
- Identify mission assurance roadblocks which retard progress and remove them or develop improvements

$\mu\text{-S/C}$ STUDY -- PROCESS FLOW **INFORMATION SOURCES** INTERNAL SURVEY µ-S/C LITERATURE OTHER SOURCES **TECHNOLOGY** = Observations SURVEY **BUILDERS** OF INFORMATION **SURVEY** Systemic Issues Screened for μ-S/C Technology List Screened for µ-S/C Applicability Applicability = Determinations Map Technologies and Systemic **Issues** into Relevant Product Assurance Areas List Frequency of Interaction between Relevant PA Areas and Technology// Systemic Issues = Recommendations Recommendations to NASA HQ

μ -S/C STUDY DETERMINATION

- Use of new technology is accelerating rapidly
- Product assurance technology assessments/implication should be periodically performed (-2 year centers)
- Technology insertion plan needed to establish degree of preflight assurance validation
- Known good die screening program for high reliability application needed
- Radiation data on commercial and advanced microelectronics needed
- Qualified MMICs and their packaging for telecommunications application is needed
- Manufacturing process critical parameter identification and control need development
- Applications for single build S/C with commercial off-the-shelf hardware needs to be understood
- u-S/C unique QA methodologies need to be identified and developed
- Advanced packaging concepts need development to optimize mass to volume ratio for $\mu\text{-S/C}$

μ -S/C STUDY DETERMINATION (cont.)

- Special light weight materials qualification approaches need clarification
- Approach systematic design assessment for off-the-shelf hardware is needed
- New redundancy strategies for high reliability applications are needed for p-sic
- New standards of reliability practice need to be established
- •Long term storage efforts on μ-S/C hardware need to be understood
- Thermal reliability is altered by power and radiating area for μ -S/C. Implications need definition.
- \bullet Radiated emissions and susceptibility of $\mu\text{-S/C}$ are affected by new densities and geometry. Implications need definition.
- Environmental testing needs refocus to p-S/C issues and logistics
- Improved defect detection and prevention methods needed

RECOMMENDATIONS

	Product Element	Deliverable
•	μ-S/C Requirements/Reduction Thrust	 μ-S/C Product Assurance Guidelines Report on process of reductions and conclusions rationale
•	Risk/Requirements Trade-offs	• Guidelines containing μ-S/C risk trade-off depictions
•	Defect Detection/Prevention	 ACEQ methodology for application to μ-S/C Cost trade-off matrices
•	Technology Insertion Plan/Process	Detailed technology insertion plan identifying technical status and required actions
•	Parts Radiation Data Base	Report on radiation data, recommended design approach, hardness methods
•	MMIC Advanced Telecom Technology	 MMIC qualification methodology List of advanced MMIC devices qualified Qualification data on qualified MMICs
•	Long Life/Long Term Storage	• Guidelines for design and test to assure μ-S/C long life/storage adequacy
•	Critical Parameters Ident. and Control	Methodology for utilizing identified critical parameters in manufacturing cycle
•	Guidance & Control Technology Qual.	Qual. methodology for ring laser gyro, micro-machined gyro, interferomic gyro
•	Test Bed Criteria for Minimal Building Hardware	Reporting containing approach for implementing reliability and environmental test concurrent with test bed development activity and criteria for validation status
•	Standard Interface Bus	Reporting containing recommended standard inst./test bed interfaces
•	Characterization of New Structural Materials	List characterizing new technology and materials data for u-S/C

μ -S/C SUMMARY

- . Maximum leverage off of μ -S/C study recommendations is obtained by:
 - . Application of top 4 recommendations to New Millennium
 - . Quick start of these tasks
 - . Rapid delivery of products (cumulative)
- . Planned activity is collected into a Safety and Mission Assurance (Code Q) thrust for New Millennium
 - NEW MILLENNIUM MISSION ASSURANCE REQUIREMENTS

Additional Title Changes are:

Recommended Title

New Name

 $\mu\text{-S/C}$ Requirements Reduction Thrust + New Millennium Requirements Development Risk Requirements Tradeoffs \rightarrow No Change Defect Detection/Prevention \rightarrow No Change Technology Insertion Plan/Process \rightarrow Technology Readiness Assurance Guideline

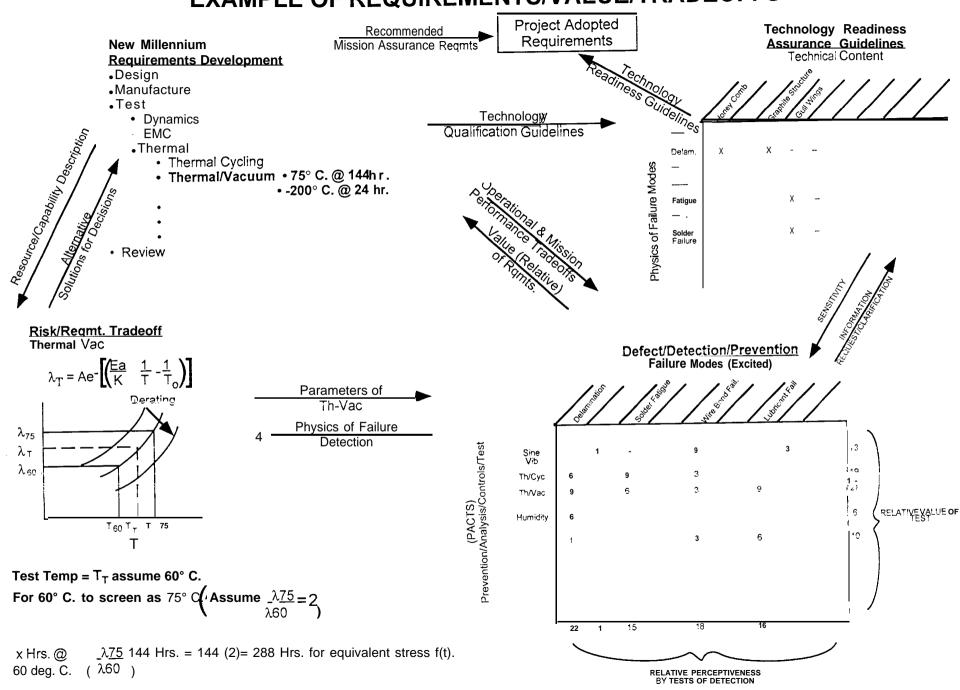
NEW MILLENNIUM MISSION ASSURANCE REQUIREMENT PROJECT ADOPTED REQUIREMENTS Design Qualification Manufacture Acceptance **NEW MILLENNIUM REQUIREMENTS DEVELOPMENT *** •Relate important requirements to existing requirement set Produce a recommended set of New Millennium product assurance requirements for project acceptance RISK/REQUIREMENTS TRADE-OFFS **TECHNOLOGY** READINESS DEFECT DETECTIONIPREVENTION ASSURANCE GUIDELINE** Depict the relationship of parameter Produce methodology for value based variations for each requirement for •Guideline to establish when technology is sufficiently producible and survivable decisions related to failure mechanisms and selected test/test conditions intelligent risk assessment and value determination for infusion into demonstration missed 4" Produce simple, clear guidelines for Produce cost trade-off matrices Collaborative effort withindustry for relative risk assessment of decisions development of repealability and which deviate from recommended qualification criteria product assurance **EXISTING ACTIVITIES CONTRIBUTE EXISTING ACTIVITIES CONTRIBUTE** Technical Risk Assessment •REL TECH Reliability Modeling •Env. Test Effectiveness Analysis Surface Mount Technology and Process •Flight Anomaly Characterization Qualification

Area Array

NASA Preferred Practices

^{*}Previously called μ -S/C Requirements Reduction, achieved through either elimination of existing_requirements or project tailoring. *Previously called μ -S/C Technology Insertion Plan.

EXAMPLE OF REQUIREMENTS/VALUE/TRADEOFFS



AN ALTERNATIVE CAN BE DEVELOPED.

CAVEAT: PHYSICS OF FAILURE THRESHOLD EFFECT CAN BE AFFECTED BY LEVEL.

SUMMARY

- . New technology and new concepts require new approaches
- . Cost and schedule are major considerations, but quality and reliability must be maintained
- . Succinct, clear, usable technical relationships must be articulated for understanding of value and content so project managers can make informed mission assurance decisions
- . Less mission assurance can be of more value when the success achieved by cost effective and prudent risk taking is greater than the cost of failure